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THE JOURNAL
OF
THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

DEVOTED TO THE ADVANCEMENT OF ASTRONOMY AND ALLIED SCIENCES

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Articles PAGE

Some Recent Advances in Astronomy - - *R. Meldrum Stewart* 57
Annual General Meeting of the R.A.S.C. - - - - - 67
When Venus is Brightest - - - - *W. T. B. Crombie* 78
Camille Flammarion, a Personal Tribute - *F. Henroteau* 83
The Facts Concerning Otto Struve's Work on Zeta Cancri (1840-1874) - - - - - - *Georg and Otto Struve* 87

Review of Publications

Measures of Double Stars (Philip Fox); Time and Relativity (C. L. Poor); Calendario del R. Osservatorio di Roma; Osservazioni e Memorie del R. Osservatorio di Arcetri - - - - - 93

Notes and Queries

An Expression of Regret; An Interesting Observation of Venus; A Still Deeper Hole; Time by the Stars; Solar Halo seen at Riviere du Loup; Closing of Sydney Observatory; Comet Hunting; Broadcasting Scientific Information - - - - - 96

Meetings of the Society

At Ottawa; At Winnipeg; At Montreal; At Toronto; At London 101

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SOME RECENT ADVANCES IN ASTRONOMY

By R. MELDRUM STEWART

(*Retiring President's Address*)

I WISH in the first place to express my appreciation of your forbearance in putting up for two years with an absentee President. So far as the President is concerned, this has been an ideal arrangement, since he has had all the honours while the Vice-President has had all the work to do; and in this connection I wish also to express my appreciation of what Mr. Hunter has done in carrying on the work of the Society so faithfully for the past two years. While it is with very natural regret that I lay down the office of President, there is a satisfaction in knowing that the man who has done the work for the past two years will for the next year or two have the honour as well.

You will perhaps have noticed that I have used a certain amount of discretion, in choosing as the title of this address "*Some* Recent Advances in Astronomy". To attempt to cover in any complete way advances in the various lines of astronomy, even throughout a single year, would be a hopeless task for one evening. I have, therefore, preferred to draw to your attention a few items only, choosing here and there those which appealed more directly to me, and which may perhaps be of interest to you.

A year ago this evening, when I last had the honour of addressing you, the Canadian eclipse party had just returned from the expedition to Long's Corners. While the section of the party from the Dominion Observatory had met with some success in the

measurement of magnetic and wireless phenomena connected with the eclipse, all visual or photographic observations had unfortunately been prevented by clouds. Parties further to the east, however, had been more successful, and many results of value were obtained. One of the most interesting features of that eclipse was the fact that for the first time an attempt was made to obtain photographs from a dirigible, the Los Angeles—an attempt which was in some measure at least a success. One of the main objects at this, as at all eclipses, was the study of the solar corona, about which, as yet, we know remarkably little. At some previous eclipses results had been obtained which were not incompatible with the assumption that the corona is composed largely of cosmic dust, but some at least of the results obtained at this eclipse appear to contradict that view, since the coronal light was found to be bluer than sunlight proper, showing that it could not be merely sunlight reflected from solid particles. From some computations that have recently been made it would appear that the molecular weight of the substance present in the corona is of the order of 1/1800, which corresponds within the limits of error with that of "electron gas"; this, however, may be taken as requiring further confirmation.

Largely as a result of the observations at this eclipse the nature of the shadow bands is now fairly well understood. They are believed to be due to irregularities in the atmospheric refraction, somewhat similar to the shadows cast by heated air rising from a stove, or from a roof or sidewalk heated by the direct rays of the sun. Under ordinary conditions shadow bands are not visible simply because of the size of the disk of the sun. But just previous and subsequent to the total phase of an eclipse, when the visible part of the sun is reduced to a narrow crescent, this condition does not hold, and the irregularities in atmospheric refraction show themselves as shimmering shadows dancing across the ground, the bands being roughly parallel to the sun's visible crescent and the direction of motion being in general that of the prevailing air currents.

At the moment we have only meagre information as to the results of observations of the recent eclipse of January 14th.

Nine parties from various countries went to the island of Sumatra to observe this eclipse. We know that some of the parties at least were successful, although thin clouds interfered to some extent. The observations proposed included a study of the corona and plates for further tests of the Einstein effect.

You will remember that for many years measurements of the solar constant have been made by the Smithsonian Institution of Washington, first in California and later also in Chile and Arizona. Small but apparently definite short period variations in the sun's radiation were found and measured, and it is the opinion of the Smithsonian officials that these may eventually be used to predict weather conditions for several weeks in advance; in fact tentative predictions have been regularly carried on for some time with, it is claimed, some measure of success. This view has not met with universal acceptance, and especially during the past year this divergence of views has come to a climax in a series of published papers, the negative being upheld mainly by officials of the United States Weather Bureau. The discussions centre largely on the question of the reality of the solar changes measured, the Weather Bureau holding that it has not by any means been established that these are not due to variations in absorption of our own atmosphere. The Smithsonian Institution holds equally tenaciously to the view that the changes are real. We may probably look forward to the matter being definitely settled within the next few years as the accuracy of the observations is increased.

The past year has been marked by the appearance of one of the most unusual novae that has so far been observed. It was discovered on May 25th by Mr. Watson, a South African amateur, at which time it was slightly fainter than the second magnitude. The maximum occurred on June 10th, when it was about of the first magnitude, since which date it has slowly declined in brightness. Once again the Harvard photographic records have proved their usefulness in tracing its previous history. It has been found to have been continuously fainter than the twelfth magnitude from 1889 up to February last; on April 13th it had already reached the third magnitude. Its rise to maximum has, therefore, been very much slower than is usually the case with novae, and the same is

true of the decline. Otherwise, it has in the main followed the usual progress of novae, though marked by some unusual features.

Although not strictly an astronomical matter it would not be fitting in a lecture of this kind in this hall to pass over the recent work of McLennan and Shrum on the famous green auroral line 5575.35. In 1923 it was announced by Vegard that he had definitely identified this hitherto unknown line as emanating from solid particles of frozen nitrogen, which he claimed would possibly be present in the upper regions of the earth's atmosphere. McLennan and Shrum, however, on repeating his experiments, proved that his line was not identical with the auroral one, and during 1924 and 1925 they carried through a series of experiments which showed that the line was due to oxygen under low pressure, and that it manifested itself only in the presence of an excess of helium or neon. As it is very likely that helium is present in considerable quantities in the upper atmosphere there appears to be no doubt that conditions are favourable, and that this is the true identification of the long mysterious auroral line.

One of the principal astronomical events of the present year was the meeting in Cambridge of the International Astronomical Union. It is impossible to enter in detail into the work accomplished at this meeting, and I shall content myself with a passing reference to two or three items of particular interest to Canada. There were six Canadian delegates present at the meeting. Of the twenty-seven permanent committees appointed to carry on the work of the Union during the next three years Canada is represented on eleven. This committee membership is distributed among eight Canadians, each of whom is on the average a member of two committees. This is possibly the largest representation in proportion to population enjoyed by any of the countries adhering to the Union, so that Canada has no cause for complaint as to appreciation abroad of her astronomical work and standing.

One of the items particularly of interest to Canada is the proposed international longitude girdle of the world, which is planned for October and November next. In this Canada proposes to participate by measurement of the longitudes of Ottawa

and Vancouver relative to points in Europe, the United States, Asia and Australia. The observations at these stations will be made by the Dominion Observatory. Connection between the various points will be established by the emission from high power stations of special wireless time signals several times each day. No longitude scheme of this magnitude has been undertaken before and we may look forward to having a longitude net of the world established with greater accuracy than hitherto. The repetition of the same programme, in whole or in part, after an interval of years, will also furnish valuable evidence for or against the Wegener theory of drift of the continents.

During the meetings an arrangement was initiated by the delegates from the Dominion Observatory for the international study of the photographic light curves of short period variables, especially those of the Cepheid type. In the case of some at least of these variables it has been established that there exist comparatively rapid fluctuations in the shape and amplitude of the light curve, and it is therefore very desirable to obtain, if possible, a succession of light curves as complete as possible. This work can evidently not be done single handed by any one observatory, on account of interruptions due to daylight and cloudy weather, so that it is necessary to arrange for continuous records by observatories widely distributed in longitude. Arrangements have already been tentatively made for beginning a definite international programme in April next.

One of the most fascinating fields of astronomical research is that relating to the size and structure of the universe. Until comparatively recently astronomers were restricted in their studies of stellar distances to the well-known method of triangulation, in which the distance from the earth to the sun was taken as the base line. A few years ago a spectroscopic method was introduced by which it is possible to measure the absolute luminosity of stars, and hence to determine the distance of stars of known magnitude provided they are bright enough to get a measurable spectrum. Other statistical and approximate methods have also been developed, so that we had a fairly good knowledge of the distances of the stars within a few thousand light years, but none

of these methods is delicate enough to reach out to the confines of the universe.

The most recent method of all is that depending on the so-called period-luminosity law which connects the periods of Cepheid variables with their absolute brightness. This law has now been definitely established, with possibly some slight reservation as to the exact value of the scale, so that if we can measure the period of any Cepheid variable, no matter how faint or far distant, and can at the same time measure its apparent magnitude, we know within comparatively narrow limits what its distance must be. A little over a year ago this method was applied by Hubble to two of the spiral nebulae, one of them being the great nebula in Andromeda. He was able by means of photographs with the hundred-inch Hooker telescope at Mount Wilson to measure the periods of a number of Cepheids in these two nebulae, and found that the distance of both of them was of the order of a million light years or 6×10^{18} miles. More recently he has, by the same method, determined the distance of the spiral nebulae N.G.C. 6822 to be about 700,000 light years.

Such distances set these objects far beyond the bounds of the Milky Way, our own universe, and seem to definitely settle the status of the spiral nebulae as "island universes" external to and separate from our own galaxy.

From a consideration of the size and structure of the universe as we see it now, we are naturally led to the question of its past and future history. Researches on the evolution of the universe have been proceeding for many years, but remarkable progress in some aspects of this question has been made within the last year or two. If we attempt to classify the stars with relation to their surface temperature and absolute luminosity, we are led to some remarkable facts. A study of stellar spectra leads to their classification in seven main types, which are designed O, B, A, F, G, K, and M. These have been shown to represent a descending scale in surface temperature; our sun is of class G. The O-type stars, which are the hottest, have surface temperatures of the order of 25,000 degrees Centigrade; the red M-type stars at the other end of the scale have surface temperatures of about 3000 degrees. The

internal temperatures are in all cases much higher, running into millions of degrees.

It is a remarkable fact that the M-type stars are found to separate themselves rather sharply into two main sub-divisions, one of which includes stars of luminosities many hundreds, or even thousands, of times that of the sun, and the other, stars on the average much fainter than the sun, with very few, if any, of intermediate brightness. In type K, which includes stars of higher surface temperature, this gap is still evident, though not so large; and as we proceed upward in the scale of surface temperatures the gap diminishes, until in types A, B and O. there is no sharp dividing line. From these statistical facts a theory of evolution of the stars was propounded, according to which it was supposed that a star began its existence as a giant star of type M, with comparatively low surface temperature but of enormous volume and extreme tenuity, and on the average about a thousand times as bright as the sun. Under the action of the mutual gravitational attraction of its own particles the star would contract as it radiated heat, the surface temperature gradually rising, the density increasing and the volume diminishing. This process would continue, the surface of the star becoming continually hotter and hotter, until it reached the condition when the density of the interior became so great that it could no longer obey the laws of a perfect gas and the action would be slowed up. This would be the period of maximum surface temperature, in which the star would be of type A, B or O, depending on its mass, and in its succeeding stages it would gradually cool down by radiation, passing again in reverse order through the types which it had traversed as a giant star, to become finally a dwarf red star of type M, and later presumably to cool still further and become a dark non-radiating mass.

According to this theory the giant stars, and they alone, would conform to the laws of a perfect gas. It occurred to mathematicians that it should be possible from purely theoretical considerations to investigate the behaviour of such a body of radiating gas under the effect of its own gravitation. With this investigation the names of Eddington and Jeans are indissolubly connected. Edding-

ton found that for a giant star the luminosity should be a function practically of the mass alone, and was able, about a year and a half ago, to deduce a formula connecting them. On investigating actual cases, he found that the giant stars were actually distributed along the curve traced out by his formula, and also discovered the then astonishing fact that the same law was followed by the dwarf stars. According to all preconceived ideas this should not have been the case, as according to the accepted ideas of evolution the very existence of the dwarf stars as such depended on their not following the laws of a perfect gas. It was pointed out, however, by Eddington that under the very high temperatures existing in the interior of the stars, amounting in most cases to millions of degrees Centigrade, the atoms would be almost completely ionized or stripped of their outer electrons, and that under such conditions matter could exist at enormously greater densities than those we are familiar with, and still obey the laws of a perfect gas. A more serious difficulty, however, presented itself, since it had been established that the intrinsically brightest stars were the stars of greatest mass, and that there was a direct correspondence between the mass of a star and its luminosity. It therefore became necessary either to throw over all our ideas as to stellar evolution or to assume that the mass of a star diminished as its age increased.

Epoch making as this new idea was, it removed many difficulties, especially those connected with the time scale required by geological theories, as it had not previously been clear that our sun could have continued radiating away energy at its present enormous rate for a sufficiently long time to account for the formation of the earth and planets, without cooling down beyond its present stage. Our present theories, on the other hand, call for the direct transformation of matter into energy, so that the ordinary star begins its life history as a body of large mass and comparatively low density and temperature. In the progress of its history, due either to increasing internal temperature, or perhaps, as claimed by Jeans, to causes not depending on temperature, a certain proportion of its mass is continually being transformed into energy, which supplements the energy derived from its contraction and enables it to continue radiating for millions of millions of

years, with its mass constantly diminishing, and passing through the same spectral stages as assumed before.

This idea of the transformation of matter into energy, startling as it seems at first sight, is perhaps not after all so contrary to our accepted ideas. It is known that inertia, the fundamental property of matter, is also a property of radiation, and this being the case, it is somewhat difficult to see what fundamental distinction there can be between matter and radiation.

Some of the new ideas involved are confirmed in various ways by independent evidence. I mentioned a few minutes ago the possibility, under the conditions of enormous temperature existing in the interior of stars, of densities far exceeding those with which we are familiar. This appears to have been confirmed during the past year by the investigations of Adams on the companion of Sirius. It will be remembered that according to the theory of relativity the spectrum lines in light radiated from a very dense body should be displaced towards the red. From our knowledge of the distance, brightness and mass of the companion of Sirius it had previously been suspected that it must be of very high density, and during the past summer it was found by Adams that the displacement of the lines in its spectrum actually agreed with this supposition. In fact, so great is its density that a pint of its material if brought to the earth would weigh about twenty tons. This investigation constitutes on the one hand perhaps the strongest evidence yet adduced for the theory of relativity, and on the other hand a remarkable confirmation of some of the newest ideas on the structure of matter and the evolution of the universe.

Another confirmation of the occurrence of radical changes in the constitution of matter, if not of its complete transformation into energy, is given by the recent investigations of Millikan on the penetrating radiation of space, which is of wave-length so short that it can arise only from radical changes in the nucleus of the atom. It is possibly direct evidence of the transformation of matter into energy taking place in far distant regions of space.

We have to contemplate then a universe in which the stars are constantly radiating away their very material into the depths of space, so that the store of matter in the universe is continually

diminishing, while space is being filled with free energy. What then is to be the end? Is the diminution of the mass of stars to continue indefinitely until all the matter in the universe has been dissipated, or is it possible that in some far distant regions of space the process is being reversed and matter re-created out of energy? Is the universe running down, or is the process, like so many of those in nature, a cyclical one, of which our experience has so far been confined to a single phase? The present state of our knowledge is not sufficient to answer this question. We must remember, however, that the history of the human race, whether it be a matter of a hundred thousand years or of a million years, is only a moment in the history even of our own earth, and that the existence of our modern civilization, and especially of our modern science, which can count only a century or so to its credit, has been inconceivably short when compared to the history of the universe. It is not surprising, therefore, if we have still many things to learn. Perhaps our successors of a few hundred thousand years, or even a few million years, hence may be able to answer these questions much better than we can to-day.

ANNUAL GENERAL MEETING OF THE ROYAL ASTRONOMICAL SOCIETY OF CANADA.

THE Annual General Meeting was held on January 12, 1926, Vice-President A. F. Hunter in the chair. The General Secretary reported as follows:—

During the past year our membership increased to 540, as compared with 514 in 1924, as will be seen from the following table:

	Membership at December 31.	
	1925	1924
Toronto, City Members	102	111
Toronto, Outside Members	137	136
Ottawa Centre	62	65
Winnipeg Centre	47	49
Victoria Centre	67	52
Montreal Centre	84	61
London, Ont., Centre	41	40
	540	514
Life Members	12	12
Honorary Fellows	11	15
	579	561

The report of your General Secretary can only be a summary of the work done by the local centres, including the City of Toronto, and it appears that these show a very active state of affairs, as will be seen by the reports which follow.

During the year three Council meetings were held for the transaction of general business, and for the purpose of guiding the affairs of the Society under somewhat changed financial conditions.

F. T. STANFORD,
General Secretary.

MEETINGS AT TORONTO

The following papers and addresses were read or delivered at the meetings in Toronto:—

Jan. 27—R. Meldrum Stewart, M.A.—The Year's Progress in Astronomy.

Feb. 10—Dr. R. K. Young—Some Features of the Eclipse of January 24th.
Mr. A. F. Miller—Atmospherical Phenomena During the Eclipse.

Feb. 24—W. E. W. Jackson, M.A.—The Magnetic State of the Earth during the solar Eclipse.
Mr. F. T. Stanford—Notes from the January Magazines in Astronomy.

March 10—John Patterson, M.A., F.R.C.S.—What We Know about Storms.

March 24—Mr. S. C. Brown—Telescopes and Their Construction.
Miss E. M. Budd—The Astronomical Magazines for February.

April 7—Mr. A. F. Miller—The Tricentenary of Cassini I.
George M. Bryce, B.A.—Shadow Bands during the recent Eclipse.

April 21—A. R. Hassard, B.C.L.—Observations for the Coming Summer.
R. A. Gray, B.A.—The March Magazines in Astronomy.

May 5—A. F. Hunter, M.A.—Notes on the Formation of Thunderstorms.
Mr. Arthur Kennedy—Hubble's Measurements of the distances of Spirals.

May 19—Miss E. M. Budd—Notes on the April Magazines in Astronomy.
Mr. J. R. Collins—Ether Theories.

Oct. 6—Mr. A. F. Miller—Observations in the Summer of 1925.
Dr. C. A. Chant—Important Auroras during September.

Oct. 20—Mr J. R. Collins—Recent Investigations, including the Ether Drift experiments.
Wm. Gore, F.C.G.L.—A Theory of the Ether.

Nov. 3—Rev. Dr. D. B. Marsh—The Bermuda Solar Eclipse Expedition to New Haven, Conn.
Miss E. M. Budd—The October Magazines in Astronomy.

Nov. 17—Mr. A. F. Miller—Camille Flammarion: his Life and Works.
Mr. F. T. Stanford—Moving pictures in Astronomy—A Trip to the Moon.

Dec. 1—Dr. C. A. Chant—The International Geographical Congress in Egypt.

Dec. 15—Dr. R. K. Young—Weather Signs and Their Scientific Explanations.
Dr. John Satterly—The Cambridge Meeting of the International Astronomical Union.

SECRETARY'S REPORT, MONTREAL CENTRE

During the session 1924-25 the Society held six meetings in the Macdonald Physics Building to which the public were invited, the lecturers and topics at these meetings being as follows:—

Dr. R. K. Young—Making Discoveries in Astronomy.

Dr. A. S. Eve—The Solar System and the Atom—a comparison and a contrast.

Prof. R. W. Wood—Invisible Light.

Dr. L. Silberstein—The Size of the Universe.

Dr. B. Boss—Stellar Motions.

Prof. A. J. Kelly—Geodesy and its relation to Astronomy.

Two of the above meetings were held under the joint auspices of this Society and Sigma Xi.

Nineteen new members were elected to the Society during the session, making a total membership at the present date of eighty-four.

A. V. DOUGLAS, *Secretary.*

SECRETARY'S REPORT, OTTAWA CENTRE.

The meetings of the Ottawa Centre for the Fall and Winter term were resumed on Nov. 12 in the Hall of the Victoria Memorial Museum. The speaker of the evening was Mr. E. A. Hodgson, M.A., Dominion Seismologist, and the subject of his address "The Teaching of Astronomy in our Schools". An account of this address has already been printed in the November issue of the JOURNAL.

On November 24 an address was given by Dr. F. Henroteau of the Dominion Observatory on "The Variable Stars of the Cepheid Type". The lecturer showed that in every one hundred stars there is about one super-giant star of tremendous volume and very small density, and among these about one in a thousand varies in brightness. It is a Cepheid. At times very bright, the brightness decreases in a few days until the stars become twice as faint, then increase usually much more rapidly than it decreased to reach the maximum light again. This phenomenon repeats itself with the regularity of clock-work.

After describing interesting peculiarities of the Cepheids the lecturer showed how they are distributed in our sidereal universe. Many are in one branch of the Milky Way, but, considered as our sidereal universe, few in the other branch; the cause of this peculiar distribution is unknown, just as the cause of the variation of light of the Cepheids.

Outside our stellar universe there are thousands of stellar universes, the spiral nebulae. Cepheids have been discovered recently in two of them, and have helped by some considerations in estimating their distances of the order of one-half a million light-years.

Mention was made of an International co-operation to study the Cepheids, organized by the lecturer at the last meetings at Cambridge of the International Astronomical Union. The Ottawa Observatory plays an important part in this co-operation, comprising observatories encircling the earth.

The regular annual meeting of the Centre was held on Dec. 10, at which the election of officers for 1926 took place and routine business was discussed.

SECRETARY'S REPORT, VICTORIA CENTRE

The Society has had a successful year, having held four Council meetings and eleven regular meetings, at which the attendance was fairly satisfactory. The addresses given before the Society were as follows:

Jan. 20—Recent Abnormal Cold Weather in British Columbia—F. Napier Denison.
Feb. 17—The Sun—W. E. Harper.
Mar. 3—The Moon and Eclipses—Prof. P. H. Elliott.
Mar 17—The Earth—R. G. Miller.
Mar. 31—The Inner Planets, Mercury, Venus, The Earth and Mars—W. H. Christie.
Apr. 14—The Asteroids, Comets and Meteors—J. A. Pearce.
Apr. 28—The Outer Planets, Jupiter, Saturn, Uranus and Neptune—J. Duff.
May 29—The Observation Meeting.
Oct. 2—The Cambridge Meeting of the International Astronomical Union—J. S. Plaskett.

Nov. 16—Ancient Volcanoes of Southern Vancouver Island—Rev. Robt. Connell.

Dec. 3—The Annual Meeting, Review of Astronomy during 1925—Retiring President J. Duff.

In addition to the above meetings the Society held a joint luncheon with the Canadian Clubs in the Empress Hotel, Sept. 22nd, at which Dr. J. S. and Mrs. Plaskett were the guests of honour. Our Honorary President addressed the meeting, giving an account of their interesting trip to England during the summer.

It is with great regret that we refer to the loss sustained by the Society in the death of Mr. B. C. Mess, 1162 Fort St. Mr. Mess had been a loyal member of the Society since 1915.

The membership now stands at 67, showing a gain of 15 during the year.

The following are the officers for the year 1926:—Honorary President—F. Napier Denison; President—P. H. Elliott, M.Sc.; Vice-President—K. M. Chadwick, C.E.; Secretary-Treasurer—R. G. Miller; Recorder—R. M. Petrie; Council—E. E. Blackwood, J. P. Hibben, H. H. Plaskett, B.A.; J. A. Pearce, M.A.; and the Past Presidents: J. S. Plaskett, D.Sc., F.R.S.; W. S. Drewry; J. E. Umbach; W. E. Harper, M.A.; and J. Duff, M.A.

J. A. PEARCE, *Secretary.*

SECRETARY'S REPORT, LONDON CENTRE

The Society has completed another successful year. All the meetings for the year were well attended and a strong interest in the study of astronomy was manifested. Last year our membership in good standing was 40, and we closed this year with a membership of 41. Already we have two new members enrolled for next year. The subjects treated during the past year were as follows.

Jan. 9—The Total Eclipse of the Sun, Jan. 24, 1925, by H. R. Kingston, M.A., Ph.D.

Feb. 13—The Reform of the Calendar, by E. T. White, B.A., D.Paed.

Mar. 13—The Refracting Telescope, by Mr. T. C. Benson.

Apr. 3—Facts, Fancies and Fallacies Regarding the Weather, by Sir Frederic Stupart, F.R.S.C.

Oct. 9—The Milky Way, by Dr. Kingston.
Nov. 13—Our Nearest Heavenly Neighbour—The Moon, by Dr. H. R. Kingston.

In June a combined picnic and observation meeting was held on Mr. W. E. Saunders' farm. This meeting was much enjoyed by the members and their friends and was largely attended. Excellent group photographs were taken on that occasion by Mr. T. C. Benson.

E. T. WHITE, *Secretary.*

(No report on the year's work from Winnipeg.)

REPORT OF TREASURER

The General Treasurer reports:—

The financial statement for the year 1925 shows a balance on hand from the year's transactions of $455.16, but it has been only by the strictest economy, and the very cordial co-operation of the various centres in accepting somewhat smaller grants from the Council, that a deficit was avoided. The JOURNAL has suffered to some extent in this matter of curtailment of expenses, although its quality has not deteriorated. It has been necessary, however, to keep down the cost of illustrations, and the size of the volume has not been quite equal to former years. The Annual At-Home, and other activities, have been financed by private contributions, and practically no additions have been made to the Library.

The financial statement follows.

FINANCIAL STATEMENT FOR YEAR ENDING DECEMBER 31st, 1925

GENERAL ACCOUNT

RECEIPTS

Cash in Bank Dec. 31st, 1924		$ 10.46
Grant from Dominion Government for 1924-5		2,000.00
Grant from City of Toronto		100.00
University of Toronto for 50 "Journals"		100.00
Fees of Members	$995.35	
Less Transferred to Life Membership Account	50.00	945.35
Sale of "Journal"		96.25
Bank Interest		39.65
		$3,291.71

DISBURSEMENTS

Publication of "Journal" and "Handbook"	$1,718.94	
Public Meetings	60.50	
Library Books Purchased	10.65	
Binding	65.15	
Stationery and Stamps	200.06	
Salaries (Assistant Librarian and Caretaker)	430.00	
Rent of Rooms	120.00	
Grants:—Ottawa Centre	56.00	
Winnipeg Centre	37.50	
Montreal Centre	54.00	
Victoria Centre	59.00	
London Centre	22.75	
Miscellaneous Expense	2.00	
Balance on hand	455.16	
		$3,291.71
Grant from Dominion Government for 1925-6, also received		$2,000.00

Audited and found correct,

J. B. FRASER,
A. R. HASSARD.

H. W. BARKER,
General Treasurer.

BUILDING ACCOUNT

RECEIPTS

Cash in Bank December 31st, 1924	$ 879.40	
Interest on Investment and on Bank Account	140.64	
		$1,020.04

DISBURSEMENTS

Canada Permanent bond purchased	$ 500.00	
Balance in Bank	520.04	
		$1,020.04

(The investments now amount to $2,500.00)

LIFE MEMBERSHIP ACCOUNT

Balance in Bank (deposited January 4th, 1926) ..... $ 50.00

Audited and found correct,

J. B. FRASER,
A. R. HASSARD.

H. W. BARKER,
General Treasurer.

TREASURER'S REPORT, MONTREAL CENTRE, NOV. 1, 1924—NOV. 1, 1925

Receipts

Balance carried forward	$ 173.22	
1 Fee 1924 (arrears)	2.00	
69 Fees, 1925	138.00	
1½ Fee sent in advance (1926-27)	3.00	
Grant from General Treasurer	54.00	
Bank interest	4.12	
		$374.34

Disbursements

Remitted fees to General Treasurer	$ 142.00	
Expenses—Lecturers	111.00	
Janitor and Lantern Services	11.50	
Postage and Miscellaneous	7.10	
Balance in Bank	101.33	
Cash in hand	1.41	
		$374.34

(Signed) A. J. Kelly, *Treasurer.*

TREASURER'S REPORT, OTTAWA CENTRE

The total receipts and expenditures for the year are as follows:

Receipts

Balance from 1924	$ 19.40
Interest on monies in Bank	0.77
Grant from General Treasurer	56.00
Total Receipts	$ 76.17

Disbursements

Advertising	$ 12.00
Printing	2.10
Meetings (Lecturer's expenses)	14.00
Postage	5.90
Incidentals	1.20
Total Expenditures	35.20
Balance on hand	40.97
Grand total	$ 76.17

It will be noted that our yearly grant this year has been the smallest in the history of the Ottawa Centre and also that our *Balance on hand* is the largest we have had in the last twelve years. This is the result of the policy of economy and retrenchment followed by the executive throughout the year.

The fees collected so far have amounted to $118.00, and further remittances are expected before the end of the calendar year. 9 members are in arrears for the current year; 3 are in arrears for two years and one in arrears for 3 years. Thus, the total amount of fees outstanding comes out at $36.00.

J. F. FREDETTE,
Local Treasurer.

Examined and found correct,

W. S. MCCLENAHAN.

TREASURER'S ACCOUNT, VICTORIA CENTRE

RECEIPTS

Balance from 1924	$ 144.76
Interest	2.70
Grant from General Council	59.00
Sale of two JOURNALS	.50
Fees, 4 for 1922, 5 for 1923, 13 for 1924, 40½ for 1925, 2 for 1926	129.00
	$ 335.96

EXPENDITURES

Rent, Victoria College	$ 20.00
Advertising	45.59
Remitted to General Treasurer	122.00
V. A. Mott	1.95
Stamp account (J. A. Pearce)	5.94
Hibben Co.	2.00
Newton Agency	3.50
Balance on hand	134.85
	$ 335.96

R. G. MILLER, Auditor.

TREASURER'S REPORT, LONDON CENTRE
(Dec. 12th, 1924, to Dec. 11th, 1925)

RECEIPTS

Balance carried forward		$ 62.82
41 members' fees for 1925		82.00
2 members' fees for 1926		4.00
Amount received from General Treasurer		22.75
Interest on deposits		1.55
		$ 173.12

DISBURSEMENTS

Fees forwarded to General Treasurer		$ 82.00
Printing		15.80
Postage, Stationery, exchange		3.32
Expenses *re* Sir Frederic Stupart's lecture		17.83
Caretaker		5.00
Cartage on telescope		2.00
Balance on hand—		
2 members' fees for 1926	$ 4.00	
Cash	43.17	47.17
		$ 173.12

Audited and found correct,
J. C. MIDDLETON,
THOS. COLERIDGE, Auditors.

E. T. WHITE,
Treasurer.

TREASURER'S REPORT, WINNIPEG CENTRE

RECEIPTS

Balance carried forward	$ 159.32
Fees for 1925	42.50
Grant from General Treasurer	37.35
	$ 239.17

EXPENDITURES

Stationery	$ 6.30
Postage	4.00
Stenographer	3.00
Donation	2.00
Balance on hand	223.87
	$ 239.17

H. B. ALLAN, *Treasurer.*

LIBRARIAN'S REPORT

The report of the Librarian was as follows:

During the year the number of periodicals received was,

From Canada and the Empire	295
From the United States	208
From other countries	212
Total	625

This is somewhat above the number for 1924, the increase being chiefly from foreign countries.

The exchange list has also been extended, resquests being received from all quarters of the earth. The numbers now on the mailing list are,

To Canada and the Empire	44
To the United States	50
To other countries	51
Total	145

On account of the reduction in income suffered by the Society, due to the withdrawal of the Ontario Government grant of $600, which had been received almost from the foundation of the Society, the amount used for the purchase of books was reduced almost to nothing, and the amount of binding done was very moderate.

The Library was used during 1925 more than usual, but the lack of space prevents effective use of much of the material on hand.

C. A. CHANT, *Librarian.*

WHEN VENUS IS BRIGHTEST

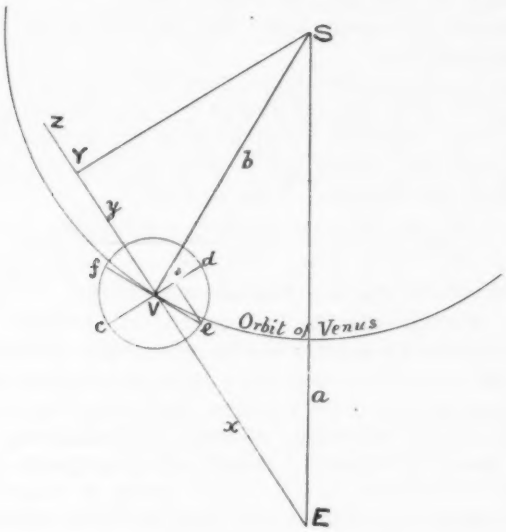
By W. T. B. Crombie

THE recent brilliancy of the planet Venus has occasioned some thoughts on this topic and on a method of calculating the time when her greatest brilliancy may be expected. What is here given is an old but simple way of attacking this problem which may be of interest to such readers as are not averse to a spice of easy mathematics in their astronomical reading.

The telescope reveals the fact that Venus (and Mercury also) presents from inferior to superior conjunction the same phases as the moon shows from the new to the full; and the same from superior to inferior conjunction as the moon from full to new. Venus would be brightest at the time of superior conjunction (for then her fully illuminated face is turned toward us), were it not that at that point of her orbit she is very far away, her own distance from the sun being added to the earth's distance from that luminary; and, as the brightness decreases as the square of the distance, this more than offsets any increase in brilliancy due to a fully illuminated disc. Hence we shall have to take into account her distance from the earth as well as the law which governs her phase at any particular time.

In the accompanying diagram let S be the sun, E the earth, V Venus, eVf the plane of illumination perpendicular to SV, cVd the plane of vision perpendicular to EV; then ed is the portion of the illuminated part seen from E, though not seen as such but projected on to cd, its width being dv, found by drawing ev perpendicular to cd. Now dv is the versed sine of the angle eVd or SVZ, seeing these two angles have the same complement SVd and are therefore equal. As seen from E, ed is the arc bounding the illuminated disc of the planet, whereas dv is the width of the crescent or lune which she presents at the time. Leaving aside

for the moment the question of her distance from the earth, the brightness of Venus varies directly as the area of the lune or crescent presented at the time. The area of the lune is a function of its width and this latter is equal to the versed sine of the angle *eVd* or *SVZ*. Hence we have this rule:—The visible illuminated part: the whole disc:: versed sine of *SVZ*: diameter of the planet.



To obtain a formula, draw *SY* perpendicular to *EVZ*. Put
$a = SE$, the earth's distance from the sun,
$b = SV$, the distance of Venus from the sun,
$x = EV$, the distance of Venus from the earth, and
$y = VY$.

Then $b-y$ = versed sine of *eVd* or of *SVZ* (or $1-\cos SVZ$), and dividing by the square of the distance we have $(b-y)/x^2$ as expressing the brightness of Venus at any time.

$$\text{Now } \frac{b-y}{x^2} = \frac{b}{x^2} - \frac{y}{x^2}.$$

We can eliminate y by applying Prop. 12, Euclid Book II, which gives us $a^2=b^2+x^2+2xy$, whence $y=(a^2-b^2-x^2)/2x$. Substituting for y in the above equation, we have

$$\frac{b}{x^2}-\frac{a^2-b^2-x^2}{2x^3}=\frac{2bx-a^2+b^2+x^2}{2x^3},$$

which expresses the brightness of the planet in terms of the distances of the planet from the sun and from the earth.

The question, however, is not the brightness of the planet but its greatest brilliancy.

Hence the fraction just found must be a maximum. To find the value of x when this function of x is a maximum proceed in the usual way. Find the x-derivative of the function treating a and b as constants, equate this to zero, and find the value of x. Put $\omega=$ the entire function. Then we have

$$\frac{d\omega}{dx}=\frac{2x^3(2b+2x)-6x^2(2bx-a^2+b^2+x^2)}{4x^6}=0,$$

from which, by the solution of an easy quadratic,

$$x=\sqrt{3a^2+b^2}-2b \quad \ldots\ldots\ldots\ldots\ldots\ldots (A).$$

Hence, if a and b are given, x can be calculated. It will be noted that in the above construction we have regarded the orbits as circular, consequently $a=1$, the mean distance of the earth from the sun $b=.72333$, the mean distance of Venus from the sun. If these numerical values be substituted in equation (A) then $x=.43036$.

In the oblique triangle EVS we have now the relative lengths of the three sides, but for the purpose of computing the time we shall require to know the angles. These are easily obtained by plane trigonometry; and, as it is no more than a class-room problem, we shall not indicate the various steps. The reader may consult any text-book he happens to have and follow the method there indicated. (Given the three sides of an oblique-angled triangle, to find the three angles). Whatever method he pursues, the results to the nearest minute of arc are as follows:

Angle $ESV=22°\ 21'=$ the difference between the long. of Venus and Earth;

Angle $SEV=39°\ 44'=$ the elongation of Venus at the time;

Angle $SVZ=ESV+SEV=62°\ 5'$.

Now the mean daily motion of Venus is 96′ 8″, while that of the Earth is 59′ 8″. Hence, Venus gains on the Earth per day 37′. (See article by the writer in JOURNAL for Oct., 1923, p. 320.) The angle *ESV* is reduced to *zero* at the moment of inferior conjunction. Hence, if we divide 22° 21′ by 37′ we obtain 36.24 as the number of days from the epoch of conjunction, both before and after, at which the maximum brilliancy takes place. If now the epoch of conjunction be computed by the method illustrated in the article above quoted, or by some other way, we have but to add and subtract 36 days 6 hours to the epoch so obtained to find the *approximate* times of greatest brilliancy. For instance, the last inferior conjunction occurred on Feb. 7, 15 hours G.C.T. Reckoning backward 36 days 6 hours we reach Jan. 2, 9 hours and forward we get Mar. 15, 21 hours as the approximate dates of greatest brilliancy.

It must be understood that these are approximate dates only, as we have proceeded upon the assumption of circular orbits and mean distances. We can now, however, adopt the precept often used in astronomical computation to secure a more accurate result, namely, make use of the approximate dates just found to correct the data we employed, and with the corrected data to recompute the dates.

Thus we see that on Jan. 2 the Earth is not at its mean distance from the sun, but at perihelion distance, and we should have taken $a = .98322$ instead of unity. Venus is also approaching her least distance, and the corrected value of b is .72027. These will furnish us a new value of x, and we shall arrive by the trigonometrical computation at dates more nearly in accordance with those furnished by the ephemeris which are Jan. 2, 21 hours and March 14, 6 hours G.C.T. as the epochs of greatest brilliancy. The approximate dates are of value in that they are derived from fundamental principles. It may be noted also that the versed sine of the angle *SVZ* (62° 5′) is .53. Hence, according to the rule above given, the disc of Venus at the epoch of her greatest brilliancy is a little more than one quarter illuminated. Hence, her albedo is very considerable.

The older writers were very fond of pointing out that Venus when brightest could cast a very noticeable shadow. To observe

this all that is necessary is to shut out the extraneous daylight as much as possible, either by receiving her light into a well-darkened room or viewing her through a tube of some length, allowing her light to fall upon a white surface, such as a piece of paper, and interposing some object to cast the shadow. Also, when Venus is brightest, she is easily seen in full daylight even at noon. There is no difficulty in seeing her. The only difficulty is in knowing where to look. The observer should form some idea of her angular distance from the sun, say, on the morning or evening previous, judging it from the sunrise or sunset point. If it should be that the planet is (or has been shortly before) in conjunction with the moon the moon serves as an excellent index by which to find her. Adopting some such device the writer has seen Venus at all hours of the day. For such observations, however, the sky must be quite free from haze. It is, of course, true that such observations as these have little scientific value, but it must be confessed that Venus is a hard object to even the very best of telescopes. Her excessive brightness introduces a great deal of glare. There is one cure that can be applied, and that is look for her in daylight. Venus in daylight is a much more satisfactory object to look at. The possessor of a small telescope should get accustomed to searching for her in daylight.

Montreal, Feb., 1926.

CAMILLE FLAMMARION, A PERSONAL TRIBUTE

By F. Henroteau

CAMILLE FLAMMARION, the great French scientist and novelist, died last year at the age of eighty-three. With a pen dipped in magic he presented the most beautiful of all sciences with marvellous skill, bringing to those less gifted than himself his own high vision of celestial things.

For more than sixty-five years he sent abroad this message: "Let your eyes rest on the azure vault of the heavens, gaze upon these mysterious golden points scattered on it, which are so many unimaginable worlds; there you will find ease for your sorrows, exaltation of your joys, and the forces of love which initiate great things."

Among his most important scientific researches may be mentioned those of double-star movements, and the studies of the physical constitution of the planets, Mars in particular.

The founding of the Société Astronomique de France was a happy incident of Flammarion's life. Its members are recruited among scientific people of every country; not only astronomers of high rank belong to this organization, but also amateurs, the list including many royal names, friends of the great astronomer.

Camille Flammarion was more than founder of this distinguished body; friend and counsellor he was to each individual. In his voluminous correspondence, letters from noted scientists are found next to those of the obscure worker seeking not merely scientific advice, but consolation for personal sorrows.

During the winter of 1924 I had the honour to be a guest of Camille Flammarion. Being invited to speak by the Astronomical Society of France, I met him for the first time at the Sorbonne. Merely at sight of him the audience burst into prolonged applause, expressing the affectionate admiration of France for that illustrious

old man. It will always be vivid, that picture of him in the president's chair, his powerful face, his penetrating eyes and his superb head with its snowy hair.

Near the Luxembourg Gardens and the National Observatory is a large ancient apartment house, Flammarion's Paris home; and from its windows one sees through a vista of ageless trees the towers, domes and spires of this gay city; but the interior presents an appeal rare even in this miracle spot on the earth; it is a museum of antiques, objects of art, trophies of every kind, manuscripts and priceless documents. In spite of the dominant personality of the Master, in such an atmosphere was keenly felt the mysticism and glamour of the unexplained, our inheritance from the days before modern research transformed conjecture and myth into an exact science.

This impression of being carried back into past ages persisted even during the charming dinner at which Madame Flammarion presided, and through that never-to-be-forgotten hour when our distinguished host, oblivious to scientific tangles, talked with intense ardour of many things modern and ancient, from astronomy to politics.

In the year 1851, Monsieur Méret, a wealthy Frenchman and great admirer of Flammarion, became possessed with the desire to make some provision for the Master which would protect him from disturbance of every kind, contribute to his comfort and well-being, and thus aid materially scientific research. As a result of this generosity Flammarion found himself presented with a castle; however, being immersed in his work and perhaps not taking the matter seriously, he neglected to acknowledge Mr. Méret's offer. Strange to say, the generous donor far from being discouraged wrote another letter imploring the author to answer, saying: "Go and visit that property and if you are not pleased, sell it."

This is the reason why many have been privileged to visit the distinguished astronomer in an environment singularly fitting as a background for his tremendous personality, his work and creative dreams.

Belonging to the royal days of France, rich in historical lore,

this property which was sold in 1791 and, after various changes in ownership, fell into the hands of Mr. Méret.

The castle stands above the quaint old village of Juvisy spread along the slope of a high hill, and is reached by climbing old stone stairs that wind between decrepit walls. Above the towers on this haunt of the kings of France, which has become a famous observatory, is built a dome and observation roof. On the ornamental gate are the words "Ad veritatem per scientiam". Surrounded by magnificent gardens and enormous trees, as Mr. Méret said, "There the century-old shadows would be for Flammarion an oasis of rest just outside Paris".

The cordial welcome of the beloved old man, who received me as a son and not a stranger, radiated that quality of spirit which drew him near to the souls of all men. The principal rooms of his home keep much of their former splendour, and the remarkably beautiful drawing rooms seemed to echo the spacious hospitality which distinguished the lords of the old régime.

More than twenty thousand volumes crowd the library, occupying rooms on the first and second floors. The oldest works date from the origin of printing and numbers of them belong to the fifteenth and sixteenth centuries. Naturally, the study and work room of the author was the centre of interest in all this enchanting place.

The museum, enriched by gifts from a multitude of friends, contains a large celestial globe built by Coronelli for Louis XIV, antique spheres, sun dials, clepsydras, a few aerolites, modern and ancient weapons, prehistoric objects, idols.

Walking with the Master in the gardens of the observatory we discussed many things close to his heart, philosophical theories, his beliefs and convictions which had changed during these later years; and always would he return to the familiar heavens, the stars which were to him living worlds instead of realms of fantastic conjecture. The charm of his simplicity and the keenness of his vision left one tingling with a sense of unearthly beauty.

In this very garden at the end of a path, there is a place surrounded by box bushes to which one finally comes, and it was there that Flammarion paused, saying: "This is my tomb, here my mortal remains will rest beside my wife, but it will be my body

only, my flesh and my bones; as for me, I shall be elsewhere, far above, but where I cannot tell you".

And now, he has left us, the great astronomer, but he has left us with a heritage not only rich in scientific achievement, but in that human understanding and joy shining from the lives of those who have attained completeness at the summit of their years.

THE FACTS CONCERNING OTTO STRUVE'S WORK ON ζ CANCRI (1840-1874)

By Georg and Otto Struve

IN the December number of the Journal of the Royal Astronomical Society of Canada there appeared an article by A. F. Miller entitled "Camille Flammarion: His Life and His Work." This article contains certain unnecessary and unfounded accusations[1] against the former director of the Poulkovo Observatory, Otto Struve. We, his grandsons, believe that the readers of the Journal will be interested in an account of the matter as it actually occurred according to the published literature.

Otto Struve's scientific standing and the high regard in which he was held universally among his colleagues were built up by his sincere and honest personality as well as by his achievements in astronomy. It is regrettable that such biographers as Mr. Miller attempt to raise the prestige of Flammarion by attacking other astronomers.

We have made a careful investigation of the available records and find the facts to be as follows:

1. In continuing the double star work of his father, Otto Struve devoted particular attention, from the beginning of his scientific career, to the study of ζ Cancri. His own observations of this star begin in 1840 and represent a continuous series of numerous micrometric measures. An inspection of his volume on double stars,[2] comprising his observations between 1840 and 1874, shows that to ζ Cancri he had devoted more space, time and energy than to any other star. As a matter of fact he had made during those 34 years a total of 237 measures of this star. Seven and one-half pages are devoted to a discussion of ζ Cancri; the next two stars, according to their number of pages, being θ Orionis and Castor, with five pages each.[3] It is thus evident that he had pursued a definite purpose in his observations of ζ Cancri. The anomaly in the

motion of the component C is so evident that it could not have escaped the attention of anyone who had access to his observations.[4]

2. It is plainly to be seen that the alleged letter of Flammarion in 1874 was not the cause of Otto Struve's interest in ζ Cancri[5]. At our request Professor N. N. Jevdokimoff, Director of the Astronomical Observatory at Kharkov, Russia, and Mr. J. P. Berkmann of the Department of Chemistry of the same University have made a thorough search for any letters of Flammarion that might be found in the old files of scientific correspondence of Otto Struve. Mr. Berkmann informs us as follows concerning the results of this search:

"Five letters of Flammarion to Otto Struve were found, belonging respectively to the years 1862, 1866, 1867, 1873 and 1874. The first three letters are of a general character and have no reference to this matter. I have copied from the last two, extracts covering everything that may have a bearing on the question.

"The letter of November 20, 1873, begins with a request to send him (Flammarion) the publications of the Pulkovo Observatory. He continues as follows: 'Essayant actuellement de construire les orbites des Etoiles doubles, dont les périodes sont les plus courtes et dont les observations sont les plus nombreuses, j'ai besoin des observations faites par vous. . . .'

"His list, copied verbatim, is as follows: 'γVirginis, ηCoronae, ζHerculis, ζCancri, depuis 1836, étoile triple, γAndromedae.'

"In the letter of April 29, 1874, Flammarion expresses his thanks to Otto Struve for having sent his observations, from which he (Flammarion) has been able to determine accurate periods of ζHerculis, ηCoronae and γVirginis.

"Expressing himself as being convinced that the observations of Otto Struve are the most accurate available, etc., etc., he asks for the following observations: '70 Ophiuchus de 1866 à 1874, ξ d, Scorpion. Σ 1998, A, B, C, ω d. Lion. Σ 1396, δ Petit Cheval Σ 2777, γ d. Couronne, Σ 1967, ζCancri, A, B et C.' Referring to the observations of ζCancri Flammarion says: 'J'ajoute ce dernier groupe, afin que si corrections personnelles dont vous m'avez parlé sont faites maintenant, vous ayez la bonté de me l'envoyer. C'est celui auquel je tiendrais le plus à cause de son importance comme *système triple*.'

"In concluding his letter Flammarion thanks Otto Struve for his interest in his (Flammarion's) work and says: '. . . j'ajouterai que je recevrais avec reconnaissance les exemples d'étoiles doubles à mouvement orbital rapide, que vous voudriez bien m'indiquer en dehors des précédentes.'"

It will be noted that the only "particulars" concerning ζ Cancri consist of Flammarion's reference to it as a "triple system". This could scarcely be regarded as new information to Otto Struve, as it had been known to be such since the time of W. Herschel.

3. Otto Struve was for many years a foreign member of the Paris Academy of Sciences, and maintained close personal relations with the leading French astronomers.[6] If Flammarion was convinced that an injustice had been inflicted upon him by Otto Struve it would have been appropriate for him to obtain *at that time* an explanation from Otto Struve through the intervention of the Paris Academy of Sciences. The fact that this was not done[7] indicates that the other members of the Paris Academy of Sciences did not share Flammarion's suspicions.[8]

4. It would seem natural to assume that a person who accuses a scientist of plagiarism has taken pains to acquaint himself thoroughly with the literature on the subject and can satisfactorily substantiate his statements. Did Mr. Miller read Otto Struve's publications on ζ Cancri before writing his article? Apparently not! Otherwise he would not have made the statement that Otto Struve reported Flammarion's discovery to the Academy as *an original one of his own*. A comparison of Otto Struve's memoir in the Comptes Rendus[9] with Flammarion's statements in his "Catalogue des Étoiles Doubles et Multiples,"[10] published in 1878 (four years after the alleged plagiarism), would have shown the two discoveries to be so different in nature as to leave no doubt of their independent origin. While Flammarion speaks only of *epicyclic irregularities in the motion of C*, Otto Struve demonstrates *the existence of a fourth attracting body*.[11] Struve's result was later confirmed by the detailed investigations of Seeliger.[12]

5. Since the designation "Germano-Russe" seems to contribute nothing to Mr. Miller's subject, it appears to be only an unfortunate expression of feeling, unworthy of further discussion.[13]

6. We are aware that Mr. Miller has extracted a large part of his material from a paper by M. E. Touchet,[14] with, however, striking changes in tone and meaning. Irrespective of any answers that we may or may not give to M. Touchet, this circumstance does not relieve Mr. Miller of responsibility for statements that appear under his name in a well-known and universally-esteemed astronomical periodical.

Observatory, Berlin-Babelsberg (G. S.).
Yerkes Observatory (O. S.).

NOTES

The following notes were written by me, after Professor Georg Struve had sailed for Johannesburg, Union of South Africa. They would, of course, have had his indorsement if a communication could have reached him.—*Otto Struve.*

[1] Journal of the Royal Astronomical Society of Canada, *19*, 276, 1925.

[2] Observations de Poulkova, vol. IX, 1878.

[3] In his discussion on ζ Cancri (Catalogue des Étoiles Doubles et Multiples, 47, 1878) Flammarion uses 56 condensed observations by Otto Struve, 33 by Dembowsky, 31 by Mädler, 27 by W. Struve, 21 by Dawes, 13 by Smyth. The rest of the observers have 10 or less observations each. There are no observations by Flammarion himself.

[4] As a matter of fact, the discovery of the irregularity in the motion of ζ Cancri in 1874 did not come entirely unexpectedly. In 1855 A. Winnecke writes (Astronomische Nachrichten, *41*, 107, 1855): "Die Beobachtungen zeigen, wohl wegen der Schwierigkeit, verursacht durch die Duplicität des Hauptsternes, für eine so grosse Distanz bedeutende Sprünge." W. E. Plummer writes in 1871 with reference to AB (Monthly Notices of the Royal Astronomical Society, *31*, 195, 1871): "The observed distances present considerable discrepancies." In their "Cycle of Celestial Objects," 1881, W. H. Smyth and G. F. Chambers make the following summary: "During the past 40 years ζ Cancri has been assiduously observed by a great number of astronomers, and much effort has been made to enlarge our knowledge of its motions. These have been found anomalous and complicated beyond precedent." In 1867 J. Winlock of the Harvard College Observatory had at two occasions suspectel C to be double (Annals of the Harvard College Observatory, *13*, 41, 1882) and G. Schnauder expresses the opinion that these observations may be real (Astronomische Nachrichten, *215*, 448, 1922).

[5] Flammarion himself writes, concerning his letter of 1874, (Catalogue des Étoiles Doubles et Multiples, 49, 1878: ". . . j'avais écrit à M. Otto Struve, pour lui demander communication de ses dernières mesures. . . ." In another place he says (Les Étoiles et les Curiosités du Ciel, 338, 1882): ". . . je voulus le (son résultat) compléter par les mesures récentes

les plus précises que je pourrais obtenir, et j'écrivis à cet égard à M. Otto Struve, directeur de l'Observatoire de Poulkowa, pour lui demander communication de ses dernières mesures sur ce remarquable système." These passages Mr. Miller translates in the following way: "He (Flammarion) therefore *sent full particulars* to Otto Struve, director of the Poulkowa Observatory." This English interpretation is thus entirely wrong.

[6]Attention is called to the fact that Otto Struve's paper on ζ Cancri was presented to the Paris Academy of Sciences by M. LeVerrier (Comptes Rendus, *79*, 1361, 1874). This distinguished French astronomer had, as Flammarion's biographers will recall, previously to 1874 discovered, from purely mechanical considerations, the existence of Neptune. It is natural to suppose that he would be particularly interested in the discovery of a dark body in the system of ζ Cancri —a very good reason why Otto Struve should send his memoir to Paris and not to one of the other astronomical centres.

[7]Otto Struve's paper on ζ Cancri was published on Dec. 20, 1874, one week after its first presentation (Comptes Rendus, *79*, 1463, 1874), and there were appended no comments about any claims of Flammarion. Flammarion writes that he deposited his "pli cacheté" on the same day (December 20, 1874). His results were not a secret in Paris, as they had been previously communicated (privately) to several astronomers, particularly to Faye, Paul and Prosper Henry and Gonzalès.

[8]Mr. Miller's statement that ". . . this disingenuous action (on the part of Otto Struve) only resulted in an exposure of his *dishonourable conduct* . . ." is a shameful misrepresentation, having no foundation in fact.

[9]Comptes Rendus, *79*, 1463, 1874.

[10]Catalogue des Étoiles Doubles et Multiples, 49, 1878.

[11]Flammarion's own book (Catalogue des Étoiles Doubles et Multiples, 49, 1878) contains the following statement: ". . . il a envoyé à la fin de l'année 1874 à l'Académie des Sciences . . . une note concluant à un mouvement irrégulier de C analogue à celui que j'avais reconnu (*avec certaines différences, néanmoins, car M.O.S. émet l'idée d'un quatrième corps, invisible et perturbateur de C*) (Our italics.) Presumably Flammarion's biographers have overlooked this statement, apparently the only one concerning this matter made by Flammarion himself in a *scientific* publication. They base their conclusions on another statement made in his *popular* book: "Les Étoiles et les Curiosités du Ciel," p. 339, 1882, in which he neglects to point out the important difference previously noted.

[12]Otto Struve's studies were continued by P. Harzer, H. v. Seeliger, G. Schnauder and others. None of these investigators utilized the work of Flammarion. Ch. André in 1900 (Traité d'Astronomic Stellaire, *2*, 140, 1900) and . , . Burnham in 1906 attribute to Otto Struve the first investigation of the irregularities of C (A General Catalogue of Double Stars, *2*, 513, 1906), although he was acquainted with Flammarion's "Catalogue" (see index of literature on the same page of Burnham's book). Burnham did not believe in

the physical reality of these irregularities. The existence of a dark perturbing body was definitely proved by Seeliger by a rediscussion of Burnham's observations. It is probably for this reason that Aitken mentions only the name of Seeliger (The Binary Stars, 102, 1918). Quite recently G. VanBiesbroeck demonstrated the existence of the fourth body from photographs made with the 40-inch Yerkes refractor (Popular Astronomy, *28*, 10, 1920).

[13]Flammarion himself referred to Otto Struve as "L'astronome russe."

[14]L'Astronomie, *39*, 341, 1925.

REVIEW OF PUBLICATIONS

The Library of the Royal Astronomical Society of Canada is indebted to the Dearborn Observatory of Northwestern University, (Evanston, Illinois) for Volume II, Annals of the Dearborn Observatory, being *Measures of Double Stars,* by Professor Philip Fox.

We learn from the headline of the volume that the observations therein published are "Measures of the Double Stars discovered by S. W. Burnham with the 18½-inch refractor of the Dearborn Observatory" (during the years 1874 to 1880 inclusive). The present catalogue gives the re-measurements of Burnham's stars made by Prof. Fox between 1915 and 1925, with a gap of more than two years while he was on military duty.

The Introduction informs us that the telescope employed is the same instrument Burnham used when compiling his long list of discoveries; and further, that, employing it, Hough made another long list of new doubles.

The author points out the greatly augmented difficulty of observation now affecting his location, due to the enormous extension of the City of Chicago with the natural accompaniments of smoke obscuration and sky-illumination by "myriads of electric lights," in spite of which serious handicap he has even gone beyond his objective by adding a list of new double stars discovered by himself.

The catalogue comprises 218 quarto pages, and contains the record of most carefully made measures of approximately 1300 objects, doubles, triples and multiples. "Following the measures are observing notes, citations of other measures, and remarks on the character of the motion, etc." (Double star observers will find the "Notes" interesting as well as valuable.)

"The magnification employed for close stars was generally the highest the seeing would warrant, 1500 being the maximum."

This bears testimony to the author's ability as an observer, as well as to the high quality of the instrument he used in the work.

Prof. Fox, using the formulae of Jackson and Furner, has deduced from the motions of 28 double stars "Hypothetical Parallaxes" for these systems, and has combined the results in a convenient *List*, also subjoining a *Table to facilitate the computation of Hypothetical Parallaxes.*

Furthermore, he has determined by means of micrometric measures *Proper Motions* in 37 cases. These are also tabulated in a convenient *List.*

The Catalogue is of course arranged in order of the stars' R.A., the positions being reduced to the standard equinox of 1950.0. Whenever possible the positions have been derived from position catalogues, while in the other instances much care has been taken to fix the positions by micrometric measures from adjacent catalogue-stars. Proper motions have been applied wherever known.

Space does not permit of any attempt to touch on the details of the Catalogue, which address themselves to double star observers or those who collect and study their results. From these Prof. Fox's work will receive the appreciation it merits.

The touching words in which the Author inscribes his Catalogue to Professor Edwin B. Frost, and refers to the blindness of that eminent astronomer, find a response in the feelings of many who (like the writer) only know Professor Frost through his published work.

A. F. M.

Time and Relativity, by Charles Lane Poor, Ph.D., Professor of Celestial Mechanics, Columbia University, New York City. (Printed by the Author.)

This is a 24-page pamphlet containing the text of a lecture delivered at the University of Michigan on May 27, 1925.

As is well known, Professor Poor has been a leading opponent of the Einstein Theory, and this is not the first assault he has made upon it. In the present publication he gives a brief history of the developments of the theory and then an account of Miller's recent

experiments on ether drift, which, it is claimed, removes the foundation on which Einstein built his theory. Then he attempts to show that the relativity theory fails to explain the perihelion motion of Mercury and also that the deflection of the light-rays in the Sun's gravitational field is not as certainly demonstrated as it was thought to be. No reference is made to the change of wave-length reported by St. John and others.

The case is presented by Professor Poor in a clear and very readable form. The present writer does not think he has disposed of the experimental verification of Einstein's predictions, but Miller's recent work has re-opened the whole subject and it will be interesting to follow the re-adjustments which may be necessary.

Calendario del R. Osservatorio Astronomico di Roma (sul Campidoglio), (104 pages, 5×7½ inches), Anno 1926.

This is volume 2, new series, of the Calendar published by the Royal Astronomical Observatory of Rome, being edited by Prof. G. Armellini, Director of the Observatory. It contains abbreviations, definitions, information regarding the Gregorian Calendar, feast-days of the English, Jewish and Mohammedan years, monthly phenomena and star maps, a review of the work done at the Observatory, magnetic and meteorological observations in Italy and astronomical tables. The book is well printed and is of convenient size for the pocket.

Osservazioni e Memorie del R. Osservatorio Astrofisico di Arcetri, (48 pages, 7½×11 inches), Firenzi, 1925.

This is part No. 42 of the Publbications of the Royal University of Florence, Italy. It contains the spectroscopic parallaxes of 275 stars of Secchi's first type; and observations of protuberances and the solar chromosphere made in 1924; both by Dr. G. Abetti, the director.

This publication shows the commendable activity of Dr. Abetti in carrying on his researches in astrophysics.

C. A. C.

NOTES AND QUERIES

Communications are invited, especially from amateurs. The Editor will try to secure answers to queries.

An Expression of Regret

The Editor has learned that a paragraph in the December issue was offensive to some of the German astronomers, and wishes to express sincere regret that this should have occurred. He is very sorry that anything was printed in the JOURNAL which could arouse hard feelings, and is anxious that peace and good-will should unite all scientific workers.

An Interesting Observation of Venus

Dr. Geoffrey Bell, of Paris, Ont., sends the following interesting observation:—

It was 5.40 p.m. on Thursday, February 4, when, having finished the day's work, I found myself outside in the presence of a rare meteorological phenomenon for this winter, namely, a cloudless sky—not only cloudless but free from haze even at the horizon. What a glorious evening! Immediately I consulted the "Handbook." Venus was within 64 hours of inferior conjunction, what a fine sight for a small telescope! But many a slip lay between the cup and the lip. As the town lies in a valley, it was necessary to hurry over half a mile of rough path, including a frozen river, several drifted fields, and lastly, a steep hill of about 100 feet, to gain the nearest unobstructed view of the western horizon. Meeting a friend willing to accompany me, we gained the summit in a minimum time by a rough and tumble race. It was a matter of ten minutes before we had regained breath sufficiently to take in the beauty of the scene presented, to say nothing of holding field-glasses or telescope. The hill commanded a complete horizon, and not a cloud in the whole heavens, except a sullen bank far down in the west, which looked like a distant line of hills. Amid the rosy glow Venus was faintly gleaming, but only a few degrees up.

Field-glasses brought it out distinct, but the crowning sight was through the little 25 power refractor with an object lens of 1¾ inches. A brilliant thin crescent, which with that magnification appeared the same as the moon to the unaided eye, but much brighter. Venus set very soon after, so we turned to descend as the twilight deepened, and Sirius blazed away in the bluish grey sky to the south-east.

A Still Deeper Hole

In the November 1925 issue of the Journal was a description of what was declared to be the deepest hole in the earth, namely, the Miley Oil Company's No. 6 well at Athens, Los Angeles County, California. In a recent number of "Science" M. E. Johnston disputes this claim. He states that the People's Natural Gas Company's well, No. 2, at McCance, Pa., is 7,756 feet deep, which is 165 feet deeper than the California well.

Time by the Stars: Another Method

In the October 1925 issue was given a method of telling the time by means of the "Big Dipper", which was devised by Dr. C. C. Wylie, of the University of Iowa. The subject is one in which boy-training organizations are interested, the ability to tell the time in this way being a part of the requirements for certain "badges". Dr. Wylie has sent to the present writer another method which may be found useful by some of our readers.

The rules are as follows:

1. Read the northern sky as a giant clock with reversed dial, that is, take the Pole Star as centre and the Pointers as moving over the dial with the hour-figures arranged in the reversed or counter-clockwise direction—III to the left, IX to the right, while XII and VI are above and below as usual.

2. Subtract the months after September 5, or add the months before September 5.

3. Double the result. This is the time in hours after noon. For instance, 14 hours after noon is 2 a.m.

Standard time is obtained by advancing the date September 5 one day for each degree west of the standard meridian, and vice

versa for stations east. Thus for Toronto (long. 79°, standard meridian 75°) take date September 9 See "Handbook", page 71).

Solar Halo seen at Riviere du Loup, Quebec

The Journal has received, through Mr. Ernest A. Hodgson, of the Dominion Observatory, Ottawa, a description and a sketch of a fine solar halo seen by Mr. J. B. Dupuis at Riviere du Loup, Quebec, at 2 p.m. on February 14, 1926.

The sky was gray and the image of the sun was very pale. About the sun was a prismatic circle (presumably of radius 22½ degrees) in which the colours were moderately strong. On this circle, to right and left of the sun, were parhelia or mock suns, and beginning at one of these and running parallel to the horizon completely round the sky to the other one, was a colourless circle. Then there was a second prismatic circle, concentric with the first, having a radius about twice as great. The colours in it were faint. Another circle, around the Zenith, touched the last-named circle at its highest point, at which place the colours were more pronounced than elsewhere.

The halo was seen for about half an hour and then gradually faded away.

Closing of Sydney Observatory

From the Astronomical Notes written by Mr. E. G. Hogg, M.A., and published by the New Zealand Astronomical Society is learned the unwelcome news that the Sydney Observatory is to be closed. The State Premier, it is said, has decided to keep up the Meteorological Bureau and to hand over the Observatory to the Federal Government—if it will accept it. Mr. Hogg gives an interesting sketch of the history of the observatory, which follows. The present writer sincerely hopes that the work of such an honourable institution will not be allowed to cease.

The Sydney Observatory was founded in 1858 on the urgent representations of the then Governor of New South Wales, Sir William Denison, and in it were installed many of the instruments acquired by the Government of the Colony when the Parramatta Observatory was closed in 1847. For some time the activities of the new Observatory were limited to the daily time-ball service, but gradually the scope of its work was en-

larged, and, under the able direction of the late Mr. H. C. Russell, F.R.S., the Government Astronomer, it came to be regarded as a first-class observatory.

In April, 1887, at a concourse of astronomers representative of nineteen different countries, held at Paris, it was decided to compile a photographic chart of the heavens on a scale never previously attempted, and the zone of the sky lying between declinations 52deg and 54deg south was allotted to Sydney. The heavy nature of the work to be done, and the great expense involved, may be seen when it is stated that 1400 photographs of the stars in the zone would have to be taken, the plates would have to be measured, the measures reduced to scale, and the final results published. By 1909 the plates had all been taken, and 750 had been measured, but none had been reduced and nothing published; since that time it would appear that little progress has been made, for at the recent meeting of the International Astronomical Union a resolution was adopted urging the Government of New South Wales to expedite the publication of the Sydney portion of the chart. This may have brought matters to a head, for one learns that the closure of the Observatory is in no small measure due to financial reasons. It is, however, to be hoped that the representations which are being made to the Government will induce it to change its policy, and provide the Observatory with the money and the staff it needs to fulfil the obligations it undertook nearly forty years ago.

Comet Hunting

In the Astronomical Notes published by the New Zealand Astronomical Society is a description of the method followed by Mr. W. Reid, a very successful comet hunter. The account is abstracted from an article in the Journal of the Astronomical Society of South Africa, and will be of interest to our readers.

He first made a map of all the nebulæ which might be mistaken for comets, following here the example set by Messier, "the ferret of comets" as Louis XV called him, by far the most successful discoverer of comets in his day. Mr. Reid is the fortunate possessor of a six-inch equatorial telescope with very fine definition—a point to which he attaches most importance; he clamps his instrument at a fixed hour angle, and then makes north and south sweeps of the sky, the diurnal motion of the earth sufficing to give him a new star field at each successive sweep. Once a month he passes his telescope over the whole southern sky, and on a good clear night will spend five or more hours patiently watching the objects defiling through his field of view. There is little use, he says, in sweeping in moonlight or with poor seeing. As Mr. Reid's catches only average about one a year, we must admire, if we cannot emulate, his perseverance:

he has his reward in the sense of intense satisfaction success brings. For the encouragement of those who do not possess telescopes as excellent as Mr. Reid's, we may say that Messier dicovered all his comets with an instrument which was only two inches in aperture.

Broadcasting Scientific Information

The Radio station of the University of Iowa, WSUI, wave-length 483.6 metres, broadcasts astronomical information on the first Monday of each month at 12.30 p.m. The talk on April 5 will be on Easter, with a few remarks on the stars and planets for the month.

A bulletin of the Ohio State University announces that Professor Menzel will give a series of talks on "Atoms and the Stars", from station WEAO, wave-length 293.9 metres, at 8 p.m., on Wednesday, June 2, 9, 16, 23.

In Toronto a series of scientific talks are being sent out by CNRT. That on February 19 was on "The Stars of Winter".

C. A. C.

MEETINGS OF THE SOCIETY

AT OTTAWA

The Annual Meeting of the Ottawa Centre of the Royal Astronomical Society was held on December 10, 1925, at which the following officers were elected:—

President, C. R. Coultee, C.E.

Vice-President, H. M. Ami, D.Sc.

Secretary, A. W. Grant, B.A.

Treasurer, J. F. Fredette, D.L.S.

Council, F. Henroteau, D.Sc.; W. W. Nichol, B.A.; J. S. Lane, B.A.; and Past Presidents R. Meldrum Stewart, M.A.; R. E. DeLury, Ph.D.; and R. J. McDiarmid, Ph.D.

The Treasurer's report showed a balance in Bank of $40,97.

The membership of the Centre is now 65, as during the year one member died, one resigned and four joined.

AT WINNIPEG

The following is a report of the Annual Meeting of the Winnipeg Centre, held Dec. 16, 1925. Vice-President Mrs. E. L. Taylor in the chair.

The financial report was read and adopted.

The following officers for 1926 were elected:—

President, Rev. T. W. Morton, B.Sc.

Vice-President, Mrs. E. L. Taylor.

Curator, L. A. H. Warren, M.A.

Treasurer, H. B. Allen.

Secretary, Mrs. S. C. Norris, 569 Sherburn St., Winnipeg.

Council, N. B. MacLean, M.A., D.S.O.; D. P. Morse, C.E.; N. R. Wilson, M.A., Ph.D.; J. H. Kolb, C. Roy, A. W. Meggett and C. F. Ellis (Asst. Secy.).

It was decided to hold one meeting a month only for this season.

The following new members were elected:—Mr. Krueger; Mr. Saunders, 87 Maryland St., Winnipeg; Mr. J. R. Williams, Belmont, Man.; Mrs. Cummings, 114 Niagara St., Winnipeg.

Dr. N. B. MacLean gave a most interesting and instructive lecture on "The Spectroscope and Its Revelations in Astronomy" (illustrated).

At the previous meeting the President, Rev. T. W. Morton lectured on "The Frontiers of Space", which was very much appreciated by a large number of people. Several good slides were shown.

HUGH B. ALLAN, *Secretary.*

AT MONTREAL

January 13, 1926.—The President, Col. W. E. Lyman in the chair.

One new member was elected: Miss M. Burland.

The question of holding several informal meetings, for the benefit of those members desirous of becoming more familiar with the elements of astronomy, the constellations, the use of the "Handbook", etc., was presented by Mr. Asbury. On the assurance that some members desired such meetings Mr. Asbury undertook to organize them.

An illustrated lecture was given by the Secretary on the Yerkes Observatory and its work.

The history and equipment of the Observatory were outlined and the regular work of the Observatory was described under the headings: visual, photographic and spectrographic. Special reference was made to the work of the late Professors Burnham, Barnard and Parkhurst; to the investigations on parallax, proper motion, radial velocites and orbits; and to the researches now in progress on the spectra of comets and novae, and on the dark clouds in the Milky Way and on the spectroscopic parallaxes of A-type stars.

The 40-inch objective of the great telescope was described and the need for its double lens system explained with the aid of small concave and convex lenses. Diffraction images were produced by interposing a grid in the path of rays of light and the application of this in photemetry was explained.

In concluding the speaker paid a sincere tribute of respect and gratitude to the members of the present staff of this great Observatory.

A. VIBERT DOUGLAS, *Secretary.*

AT TORONTO

February 9, 1926.—The regular meeting was held in the Physics Building at 8 p.m., the President, Mr. A. F. Hunter, in the chair.

A letter from Thos. Waddell, of Brechin, Ont., was read, in which he spoke appreciatively of the JOURNAL. A letter was also received from Mr. Cyril Ellis of North Battleford, Sask., respecting the conjunction of Jupiter and the moon on December 17 last.

Fifteen nominations for membership were made.

Mr. A. R. Hassard, B.C.L., addressed the meeting on "Mirages and other Summer Observations", speaking first of the interesting triple conjunction on the night of July 10th last of Mercury, Venus and Mars. He had watched for several evenings the approach of this interesting conjunction. Mercury was of that silvery whiteness that baffles description, looking like a pale silver coin which lacked polish. Mars, almost always ruddy in colour, had a pale tinge also, a dull pink, while all were overborne by the constant brilliancy of Venus, which, no difference where situated, whether loftily in the sky or embedded in the mists of the horizon and the

light of the newly set sun, has always the same brilliant, glittering glow. The approach first, and later the separation, of these three planets, with the crescent moon near by, were of spectacular interest.

Next, he touched on a wonderful meteor which crossed the constellation Scorpio on the night of July 14th last. The meteor flashed across the sky near the star Antares (named as being the rival of the planet Mars in ruddiness), leaving a brilliant trail behind it. The fainter part of the trail lasted for seven or eight seconds, but for a period of nearly fifty seconds the more brilliant part of the trail lasted, and finlly the glare faded and died out slowly. During this time, and for some time afterward, he listened for a sound from the meteor, but none came. The trail was very thick and its brilliant part was probably about five degrees long. It was excessively white, like a silver streak in the sky. Several persons with whom he was sitting, at the time, all saw it, as they were directly facing it. There was no accompanying detonation or sound of any kind. Incidentally, he referred to the difficulty in verifying the evidence of many persons in respect to meteors generally.

He next spoke of some mirages he has frequently seen across Lake Ontario from his summer cottage in New Toronto, the width of the lake there being 28 miles. The cottage is in longitude 79° 30′ W., and about 10 miles west of Yonge Street. Grimsby and Beamsville are situated on the shelf of flat land between the lake and the Niagara escarpment, which is three miles further inland, making it 31 miles from his cottage to the escarpment. Speaking in a general way, at a distance of about 30 miles, an object on the earth's surface would be about 500 feet below the line of vision. At certain times the escarpment appears from his cottage to be elevated above the water of the lake,—*i.e.*, to be miraged, or lifted out of its setting and placed slightly above the waters far to the south. With a continuous observation of the southern shore of Lake Ontario when motoring from his place to Hamilton, the mirage seems to gradually merge into the real shoreline of the lake as he approaches Burlington, and he pointed out that the two appearances seem to conflict with each other; yet, the direct view cross the lake, appearing at times with marvellous distinctness, but at other times vanishing entirely, must be a mirage effect.

Mr. Hassard spoke briefly of the water levels in the great lakes, and the causes of the lowering of the lake levels, which he ascribed to the small amount of precipitation of snow and rain in the last few years. Very little snow or rain has fallen, at least in this part of Ontario, during the past three or four years.

Following the address, there was a discussion of some of the points raised, in which several took part, the chairman stating that he had distinctly seen mirages of the same Niagara escarpment, or rather the continuation of it in Simcoe country about thirty miles west of Barrie,

especially in the autumns, across the wide valley of the Nottawasaga River. He also stated that the average snowfall in Toronto per winter is 2½ feet, while at one degree of latitude—roughly, 70 miles—to the northward, it is five feet. And at a still further degree north—say, in the neighbourhood of Parry Sound—the total winter snowfall is about 10 feet. Another speaker stated that on the western plains he had seen cattle apparently half a mile distant, but they were really five miles away. He had climbed a water tower to satisfy himself on the subject, because he did not want to incur any risks as he had been chased once by some 500 flying cattle, and did not seek a repetition of the experience. Another speaker alluded to the view he once had of a Rocky Mountain mirage, in which he saw the mountains both to the east and to the west of him, as if hemming him in. Still another experienced observer had seen houses one on top of another—one upright, the other inverted, while still another had seen the mirage three times repeated, *i.e.*, the images three times multiplied. (Illustrations of this appear in W. J. Humphreys' work on the atmosphere). Mr. Hassard quoted the evidence of one who saw two Saskatchewan towns elevated in the sky, one above the other, and on the streets of the nearer one, seven miles away, people actually walking along the streets, seen with wonderful distinctness. It transpired from the discussion that apparently about thirty miles is the limit at which objects are miraged.

AT LONDON

The November meeting was held on Friday, November 13, 1925, in the Public Library, Dr. H. R. Kingston presiding.

It was decided to hold the December meeting at the Normal School and to make it in part a social evening. Mr. Thos. Coleridge and Mr. J. C. Middleton were appointed auditors.

The address of the evening was given by Dr. Kingston on "Our Nearest Heavenly Neighbour—the Moon". Dr. Kingston pointed out that it is not difficult to show that the moon moves among the stars, making its journey around the earth. By means of a slide he showed the gradual occultation of Venus by the moon. The relative sizes of the earth and the moon were demonstrated by means of small balloons. Using a lantern slide the phases of the moon were pictured on the screen and then with a flashlight and a balloon the manner in which these phases were produced was made clear. A fine series of slides were used to show the surface of the moon as seen through a telescope. The so-called seas and the mountains with the wonderful shadow effects made by the light shining on the mountain peak and into the deep hollows were clearly shown and described.

E. T. White, *Secretary.*

The Royal Astronomical Society of Canada

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Council—E. E. Blackwood, J. P. Hibben, J. A. Pearce, H. H. Plaskett, and Past Presidents: F. Napier Denison, W. S. Drewry, J. E. Umbach, W. E. Harper, M.A., and J. Duff, M.A.